Research Report

EVENT CLUSTERS: An Organization of Personal Events in Autobiographical Memory

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Abstract—*The present study employed a method called* event cuing *to investigate the organization of autobiographical memory. The unique feature of this method is the use of event descriptions as retrieval cues. Participants first recalled a set of personal events. Next, they responded to each of these cuing events by retrieving a second related personal event (the cued event). Subsequently, relations between cued and cuing events were coded by the participants, and all events were dated and rated for importance. Results indicate that memorable personal events, regardless of age or importance, are often embedded in* event clusters*; that events organized by these clusters, like episodes in a story, are often causally related, temporally proximate, and similar in content; and that narrative processes may not be necessary for the formation of event clusters, though subsequent narration may affect their contents and structure.*

Despite hectic schedules, fragmented days, and competing demands, there is a basic coherence to people's lives: Goals are established and pursued, plans are generated and executed, and so on. More generally, actions are often caused by prior events and spawn subsequent ones, and people seem to recognize those events that form a coherent sequence, even when they differ from one another in content, are separated in time and space, and are interspersed among events from other sequences (Neisser, 1986).

The present study was conducted to determine whether memory for personal events reflects this coherence. There are three reasons for believing it might. First, memory processes promote associations between items that are similar in content or temporally contiguous. If events belonging to the same sequence often occur close in time and share common elements (e.g., participants, settings, props), traces formed by these events should be linked in memory. Moreover, planning, execution, and evaluation of goal-directed actions engage cognitive processes, such as causal reasoning and counterfactual thinking, that coordinate present and past events (Hayes-Roth & Hayes-Roth, 1979; Roese & Olson, 1995; Trabasso & van den Broek, 1985). It is likely that these processes create or strengthen associations between the memory traces produced by related events even when they are temporally discontinuous. Together, these basic memory and cognitive processes should produce associative structures that draw together related event memories and that retain information about their temporal and causal relations.

Second, people often create stories around significant or unusual personal events (e.g., Bruner, 1991; Robinson & Taylor, in press). It is possible that processes involved in constructing and communicating personal narratives affect the organization and content of autobiographical memory. Specifically, compositional processes should reinforce existing interevent associations and may create new ones, and subsequent narrations should impede forgetting of constituent events and their relations. Finally, a wide variety of evidence indicates that some, if not all, event memories are part of larger narrative-like memory structures (Anderson & Conway, 1993; N.R. Brown, 1990; Bruner & Feldman, 1996; Robinson, 1992; Robinson & Taylor, in press; Schank & Abelson, 1995; Thompson, Skowronski, & Betz, 1993).

The preceding discussion suggests that memorable personal events may often be embedded in *event clusters*. An event cluster is defined as a memory structure that organizes information about a set of causally and thematically related events.[1] There is a growing consensus that these narrative-like structures "are a primary form of organization in autobiographical memory" (Robinson, 1992, p. 223; also see Barsalou, 1988; N.R. Brown, 1990; Bruner, 1991; Conway, 1996; Fivush, 1991; Linton, 1986; Nelson, 1993; Schank & Abelson, 1995). Nonetheless, as Conway (1996) correctly observed, the "organization of general-event knowledge [Conway's term for event clusters] has yet to be extensively investigated, and the variety, structure, and frequency of mini-histories [Robinson's term] are currently unknown" (p. 69).

The present study employed a method, called *event cuing*, devised to determine whether event memories are frequently embedded in event clusters and to identify the relations that associated event memories have in common (N.R. Brown, 1990; Fitzgerald, 1980). Event cuing is a variant on the standard cuing task used to investigate the temporal distribution of personal events, relative cuing efficiency of different concepts, and the hierarchical organization of autobiographical memory (Conway & Bekerian, 1987; Reisser, Black, & Abelson, 1985; Robinson, 1976; Rubin, 1982; Rubin, Wetzler, & Nebes, 1986). In these experiments, participants are presented with a cue word or phrase and recall a related personal memory. For example, a person cued with the word *dog* might respond, "I watched my dog, Benji, ride off after giving him away."

Because standard word- and phrase-cues do not refer to personal events, they cannot be used to study how event memories are related to one another (N.R. Brown, 1993). To do this, it is necessary to use event memories as probes and to obtain event memories as responses. The event-cuing method implements this idea. Specifically, participants are required to respond to each cue with a related personal event. However, the cue is not a word or phrase selected by the experimenter, but rather a sentence previously generated by the participant, describing an event from his or her own life. For example, in the current experiment, one participant first recalled, "I cut my finger on a tube

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1. We use this term in preference to others in the literature (e.g., general event, personal narrative, mini-histories) because it conveys the idea that each cluster coordinates multiple event memories (cf. general event) and because it does not imply that the creation of these units depends on the operation of specific narrative processes (cf. personal narrative).

with radioactive toxin in it." Later, this description was presented as a *cuing event,* and she responded with the following *cued event*: "I spent nearly two hours waiting to see the nurse at this hospital."

If event memories are associated to one another in a systematic manner, and if people typically recall an associated event memory when responding to an event cue, then relations holding between cued and cuing events should correspond to the type of associations that bind event memories, and the frequency of these relations should reflect their organizational importance (N.R. Brown, 1990). Thus, if personal events are typically embedded in event clusters, cued events should often be drawn from the same cluster as cuing events. Moreover, if event clusters are narrative-like, then cuing and cued events should often be causally related, as in the preceding example, and may share other components (e.g., two events may refer to the same people or take place in the same location).

In the present experiment, the event-cuing task was the second of five tasks. To begin, participants were divided into two groups: an *important-event* group and a *word-cued* group. In the first task, important-event participants recalled important life events, and word-cued participants responded to each of a series of cue words with the memory of a related personal event. This first task was manipulated to ensure that important and unimportant event memories would be recalled and used as event cues during the second task.

The remaining phases produced information about events recalled during the first two tasks. Task 3 was particularly important as it provided data concerning the frequency of various interevent associations. During this task, each pair of cuing and cued events was presented together on a computer display, along with a menu describing ways in which events might be related. Participants selected which option (or options) described how the paired events were related. Specifically, they indicated whether the cuing and cued events involved the same people or activities, whether the two events took place at the same location, whether one event caused the other, whether one event was a part of the other, or whether both events were part of some larger story. A positive response to one or more of the latter three options indicated that the participant considered the events in the pair to be members of the same event cluster. During the fourth task, participants estimated when each event happened, and during the fifth, they rated the personal importance of each event.

For reasons already stated, all participants were expected to produce many clustered pairs. In addition, the present study was designed to determine whether the importance of a cuing event is related to the probability that it will be part of an event cluster. There seemed to be three possible outcomes. First, the probability that a cuing and cued event belong to the same cluster might be very high and unrelated to the importance, age, or origin of the cuing event. This would be consistent with the view that the formation of event clusters is an inevitable, if incidental, consequence of coordinating and evaluating memorable, goal-directed behaviors. A second possibility was that an important event would almost always elicit the memory of another event from the same event sequence and that an unimportant event would almost never elicit such memories. This reasoning assumes that some form of narrative processing is necessary to create and maintain event clusters (Barclay, 1996; Fivush, 1991; Nelson, 1993) and that important events are likely to receive this type of processing, and unimportant events are not (R. Brown & Kulik, 1977; Burt, Mitchell, Raggatt, Jones, & Cowan, 1995; Conway et al., 1994). The third possibility was that cuing events, regardless of their importance, would often elicit same-cluster event memories, but that clustered pairs would be more common when the cuing event was important than when it was unimportant. The assumptions underlying this possibility are that normal event processing often results in the creation of event clusters; that interevent associations created by these processes may be forgotten if not rehearsed; that narration serves to strengthen existing associations and, perhaps, create new ones; and that important events are more likely than unimportant ones to be narrated.

Of course, it could be that personal events are rarely embedded in narrative-like structures and that some other principle determines how people structure their past. There is, in fact, an alternative perspective that holds that event memories are organized by the concepts they embody. Work by Schank and colleagues (e.g., Kolodner, 1983; Reisser et al., 1985; Schank, 1982) typifies this approach. These researchers have argued that autobiographical memory is organized around action concepts like "dining out," "shopping," or "getting injured." According to this view, the most likely response to an event cue would be another event from the same action category. For example, the memory of cutting a finger should evoke the memory of another injury (e.g., "A horse stepped on my foot, breaking a toe"), rather than the memory of a causally related event (e.g., the resulting trip to the emergency room). In addition, person-based theories of event memory (e.g., Hastie, 1988; Srull & Wyer, 1989) predict that the same people should play a role in a pair of cuing and cued events. One could also imagine location-based or object-based theories predicting that events would share locations or objects, respectively, but little else. More generally, because event-cuing and relation-coding tasks produce information about the nature and frequency of the associations that bind event memories, this method provides empirical grounds for choosing between competing organizational schemes.

METHOD

Procedure

Participants in the important-event and word-cued groups performed five tasks. At the outset of the experiment, important-event participants were given 5 min to review their lives. Then, during Task 1, they briefly described 14 highly significant personal events. Word-cued participants were not asked to review their lives, nor were they instructed to recall important events during Task 1. Rather, they were presented with 14 concrete nouns and asked to respond to each with the first related personal event that came to mind. Event descriptions generated during Task 1 served as retrieval cues during Task 2. During this task, participants were required to respond to each cue by retrieving, as quickly as possible, the memory of a related personal event. At the beginning of each task, participants were told that each retrieved memory should refer to a specific personal event that lasted no more than a few hours. Also, the Task 2 instructions noted that the cued and cuing events might be related in a number of ways and warned participants that they should not respond with trivial details of the cuing event, with statements concerning their emotional states during the event, or with evaluative statements.

With the exception of these differences, the procedures followed during Tasks 1 and 2 were identical. Participants were seated at a computer terminal and initiated a trial by pressing the "enter" key in response to a message presented on the video display. When this key was pressed, the initiation prompt was replaced by a generic retrieval prompt (Task 1, important-event group), a cue word (Task 1, word-cued group), or an event cue (Task 2). In each case, participants were instructed to press the space bar as soon as they had an appropriate event memory in mind. Pressing the space bar caused a new message to appear ("Enter your response"), along with an 80-character-wide response field. Participants typed a short description of the remembered event in the response field, and then pressed "enter," completing the trial. Each response yielded a retrieval time, which was measured from the onset of the retrieval prompt, cue word, or event cue until the participant hit the space bar. If a participant failed to respond to a prompt or cue within 90 s, the trial was terminated.

Tasks 3 through 5 were untimed and self-paced. On each trial during Task 3, participants were presented an event pair (i.e., a cuing event and the cued event it elicited) and a menu that listed the following questions on separate lines:

Did Event A (the cuing event) and Event B (the cued event) involve the same person or persons?

Did Event A and Event B involve the same activity?

Did Event A and Event B occur at the same location?

Did one of the events cause the other?

Is one of the events part of the other?

Are both of these events part of a single broader event?

Are Event A and Event B related in some other way?

Participants responded to each question by typing "y" for "yes" or "n" for "no" in an associated response field.

During Tasks 4 and 5, participants were presented with the event descriptions generated during the first and second tasks. During the fourth task, participants estimated the day, month, and year when each of the recalled events occurred, and during the fifth task, they rated the personal importance of each event on a scale from 1 (*not important at all*) to 5 (*extremely important*).

The first two events recalled in the word-cued condition and the last two recalled in the important-event condition served as practice items during subsequent tasks. Otherwise, cuing events were presented in a random order during Task 2, and the event pairs were presented in a random order during Task 3. Cuing and cued events were presented randomly in Tasks 4 and 5, with the constraint that when one member of a pair appeared during the first half of the task, the other appeared during the second.

Participants

One hundred and fifty University of Alberta students participated in this experiment. All were enrolled in an introductory psychology course and received course credit for their time. Half were randomly assigned to the important-event condition, and half to the word-cued condition (for both groups, median age = 19), and each was tested individually in a session lasting from 1.5 to 2 hr.

RESULTS AND DISCUSSION

Because data from the practice trials were eliminated, each participant could contribute a maximum of 12 event pairs. However, data were not collected when a participant failed to respond within 90 s during Task 1, responses concerning cuing events were discarded when the participant did not respond within 90 s during Task 2, and both events in a pair were discarded when either was judged to be inappropriate. Appropriate responses were ones that referred to specific autobiographical events, whereas inappropriate responses described recurring events, emotional states or responses, minor details of the cuing event, or general aspects of the self or the world. Finally, all data produced by 7 participants (6 from the word-cued group and 1 from the important-event group) were discarded because these people produced fewer than 7 acceptable event pairs each. On average, each of the remaining important-event participants produced 11.1 acceptable event pairs, and each of the remaining word-cued participants produced 10.7.

Between-Group Comparisons

A mean importance rating and a median event age were computed for acceptable cuing and cued events for each participant. In addition, the percentage of event pairs in Task 3 eliciting a "yes" response was calculated for each participant and relation. Means, computed across participants and within groups, are presented in Table 1. Event memories retrieved by important-event participants during Task 1 tended to be older and more important than those produced by word-cued participants. These differences occurred because participants in the word-cued group often recalled recent mundane events, and those in the important-event group did not. Results of a more detailed analysis were consistent with this claim and prior research (Fitzgerald, 1988; Fromholt & Larsen, 1991): Participants in the word-cued group were

Table 1. *Mean responses to questions about cuing and cued events*

Response	Important-event group	Word-cued group
Age of cuing event (days)	1,627*	908*
Age of cued event (days)	1,429*	914*
Rated importance of cuing event[a]	3.76*	3.11*
Rated importance of cued event[a]	2.98	3.00
Paired events involved the same person (%)	50	49
Paired events involved the same activity (%)	35	39
Paired events occurred at the same location (%)	43*	52*
One paired event caused the other (%)	60*	46*
Paired events were part of the same story (%)	37	39
One paired event was part of the other (%)	44	38
Paired events are related in another way (%)	21	19

[a]Importance was rated on a scale from 1 (*not important at all*) to 5 (*extremely important*).
*Reliable between-group differences (df = 141), $p < .05$.

much more likely than those in the important-event group to retrieve events that had happened during the preceding 6 months (28% vs. 11% of retrieved events), and these recent events typically received low importance ratings from the participants in the word-cued group ($M = 2.74$) and high ones from those in the important-event group ($M = 4.12$).

In Task 2, important-event participants again retrieved significantly older event memories than word-cued participants. This difference is explained by the fact that cuing events, regardless of condition, often elicited cued events of approximately the same age (see results later in this section). Rank-order correlations between the age of the cuing and cued events taken over all event pairs were .82 and .84 for the important-event and word-cued conditions, respectively (see N.R. Brown & Schopflocher, 1998, for further discussion of the temporal characteristics of this task). Rated importance of the cued events did not differ between groups.

If the organization of autobiographical memory is concept-based, almost all event pairs should share one type of event relation (e.g., activity), and other types of relations should be relatively uncommon. Data presented in Table 1 indicate that all event relations were well represented across conditions.[2] Thus, it is unlikely that event memories are organized by a single type of concept (cf. Barsalou, 1988; Reisser et al., 1985).[3] Admittedly, paired events produced by important-event participants were more likely to have been causally related (see results later in this section) and less likely to have taken place at the same location than those produced by word-cued participants. Nonetheless, the pattern of codings was similar across groups despite very different cue-generation tasks. This result is inconsistent with the view that performance on Task 2 reflected task demands set up by Task 1.

Clustering and Importance

One goal of this study was to determine whether event memories are often embedded in event clusters, and if they are, whether important events are more likely to be part of event clusters than unimportant events. Again, events were considered to be members of the same cluster if the participant indicated during Task 3 that pair members were causally related, members of the same broader story, or nested within one another. Figure 1 displays the percentage of clustered pairs as a function of the rated importance of the cuing event. Clearly, participants often responded to the cuing event by recalling another event from the same cluster, and this was true regardless of the rated importance or origin of the cuing event; overall, 77% of the event pairs were clustered, with even unimportant cuing events eliciting cluster-mates more often than not. Also, as this figure suggests, participants in the important-event group produced more clustered pairs (82%) than those in the word-cued group (72%), and the percentage of clustered pairs increased with rated importance of the cuing event.

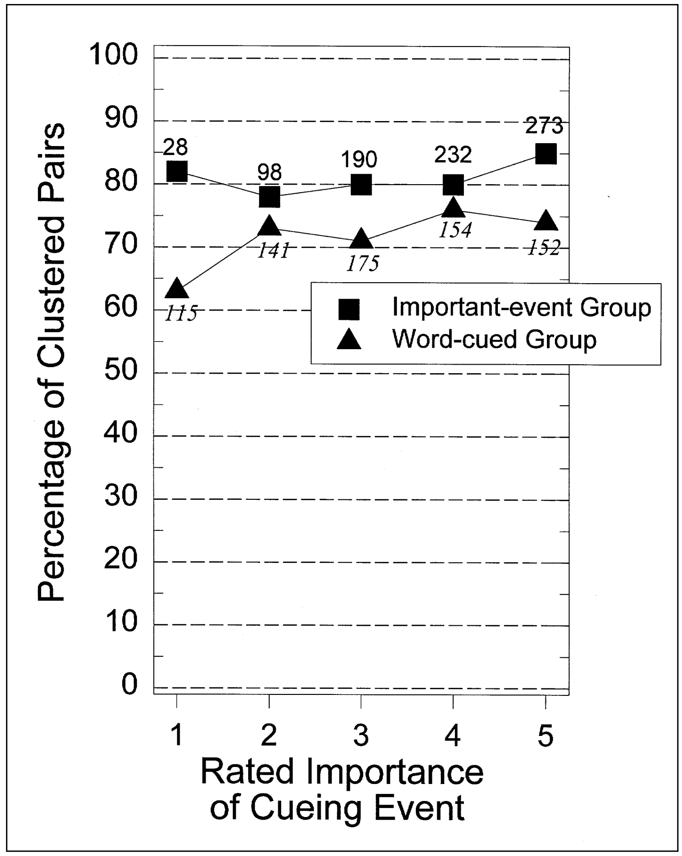

Fig. 1. Percentage of clustered pairs as a function of the rated importance of the cuing event. (Higher ratings indicate greater importance.) Numbers represent the total number of cuing events at each level of rated importance for the important-event and word-cued (italics) groups.

Collapsed over groups, the corresponding percentages for the five levels of rated importance were 66%, 75%, 76%, 78%, and 81%.

Statistical support for these observations comes from split-plot, repeated measures analysis that regressed clustering against group, rated importance, and their interaction. This analysis indicated that clustered pairs were more common in the important-event condition, $\beta = 0.10$, $F(1, 141) = 7.68$, $p < .01$; that clustering increased with importance of the cuing event, $\beta = 0.02$, $F(10, 1410) = 1.70$, $p < .05$; and that the form of this relationship did not differ between the groups. A comparable regression analysis indicated that clustering was unrelated to the age of events.

Briefly, these analyses indicate that personal events, regardless of their age or importance, are often part of event clusters. This finding is consistent with the view that clustering is a common consequence of planning, execution, and evaluation of meaningful actions. In addition, important cuing events were somewhat more likely than unimportant events to elicit cluster-mates. If we assume that people discuss important events more than unimportant events, the relation between importance and clustering suggests that narration serves to maintain or strengthen associations between clustered event memories. Finally, there was a relationship between the nature of the generation task and clustering; for a given level of rated importance, cuing events generat-

2. In a control study, participants who coded relations between randomly paired word-cued event memories very rarely indicated that the paired events shared common elements. This finding indicates that people are not simply biased to detect or report relations.

3. Cluster analyses of the event codings provided no evidence that any substantial subgrouping of memories shared a single code to the exclusion of others. Rather, groupings that emerged strongly suggested the joint occurrence of multiple codes including at least one of the three event-cluster indicators.

ed in the important-event condition were more likely to elicit cluster-mates than those generated in the cue-word condition. This unexpected result may be an artifact. It could be that the two groups used the importance rating scale differently, with the important-event group adopting more stringent cutoffs than the word-cued group (Parducci & Perrett, 1971). If so, event memories produced by word-cued participants would have received higher importance ratings than comparable memories produced by important-event participants. Thus, with rated importance held constant, clustering should have been less common in the former condition than in the latter.

Differences Between Clustered and Nonclustered Pairs

In addition to being more common, clustered pairs differed from nonclustered pairs in several ways. First, response times during Task 2 were faster when the cuing and cued event were from the same cluster than when they were not; collapsed over condition, median retrieval time was 6.99 s for the former and 8.27 s for the latter (Mann-Whitney U = 194,879.5, z = 2.77, p < .01). Apparently, less search or reconstruction was required when the cuing event was embedded in a cluster than when it was not. Second, the date estimates indicated that clustered events often happened close together in time and that nonclustered events did not; the median difference between the age of the cuing and cued events was only 2 days for clustered pairs and 317 days for nonclustered pairs (Mann-Whitney U = 102,429.5, z = 15.44, p < .001). Third, clustered pairs were more likely than nonclustered pairs to share participants (51% vs. 43%, $\chi^2[1, N = 1{,}558] = 7.29$, p < .01), activities (38% vs. 31%, $\chi^2[1, N = 1{,}558] = 3.84$, p < .05), and locations (51% vs. 31%, $\chi^2[1, N = 1{,}558] = 43.88$, p < .001), but less likely to be related in other ways (16% vs. 34%, $\chi^2[1, N = 1{,}558]$ = 53.32, p < .001). Fourth, participants indicated that more than two thirds (68%) of the clustered pairs were composed of causally related events. In other words, it appears that events in a cluster, like adjacent episodes in a story, are often causally related and temporally proximate, and they often share concrete plot elements.

CONCLUSION

To summarize, the present study indicates that memorable personal events, regardless of age or importance, are often embedded in event clusters and that events organized by these clusters, like episodes in a story, are often causally related, temporally proximate, and similar in content. It can also be argued that clusters are created when people plan, execute, and evaluate meaningful action sequences and that subsequent rehearsal or narration serves to maintain or strengthen associations between clustered events. It is true that a number of important issues remain unresolved. For example, it is unclear why more than 20% of the cuing events failed to elicit cluster-mates, or why it should take almost 7 s to retrieve an event from a cued cluster. Nonetheless, this work does serve four important functions. First, it provides direct support for prior claims concerning the organizational importance of event clusters. Second, it suggests that narrative processes may not be necessary for the formation of event clusters, but that subsequent narration may well affect their contents and structure. Third, it demonstrates that event cuing is an effective method for studying personal memories. Finally, it implies that an accurate model of autobiographical memory will require a detailed understanding of the associations that link event memories to one another, the processes that create these links and alter them over time, and the way that these processes are coordinated to create coherent, accessible memories from complex event sequences.

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